Chapter 4

Risk Assessment

Introduction

The level of service provided by a fire & EMS department should be based on the agency's ability to cope with the various types and sizes of emergencies that they can reasonably expect after conducting a risk assessment. Overall community risk management consists of risk assessment and risk control. First, the department needs to identify the magnitude and scope of the risk of fire, rescue, and medical emergencies, or other hazards that threaten life, safety, property, or the environment. This analysis is based upon both actual and potential losses.

Developing a risk assessment traditionally involves an analysis of six key components. These apply to all fire, rescue, medical and miscellaneous calls for service. The six components include:

- **Fire Flow** (water) – the amount of water required to both control and extinguish a fire emergency, based on the contents, square footage, construction type, and the use of combustible materials.
- **Probability** – the likelihood that a particular event will occur within a given period of time. An event that occurs daily is highly probable. An event that occurs only once in a century is very unlikely. Probability is an estimate of how often an event will occur, based on local historical data.
- **Consequence** – two primary components: life safety (risk to the lives of occupants and responders from life-threatening situations that include fire, rescue, hazardous substance and emergency medical events) and economic impact (the loss of property, income or irreplaceable assets).
- **Occupancy risk** – an assessment of the relative risk to life and property resulting from a fire inherent in a specific occupancy or in generic occupancy classes.
- **Demand zones** – geographic area utilized to analyze risk situations. Lynchburg uses "response zones" as its primary type of demand zone for analysis purposes. Response zones are based on current fire station locations and correspond to the first-due response area for each of the stations. Current fire station placement and resource assignment has been

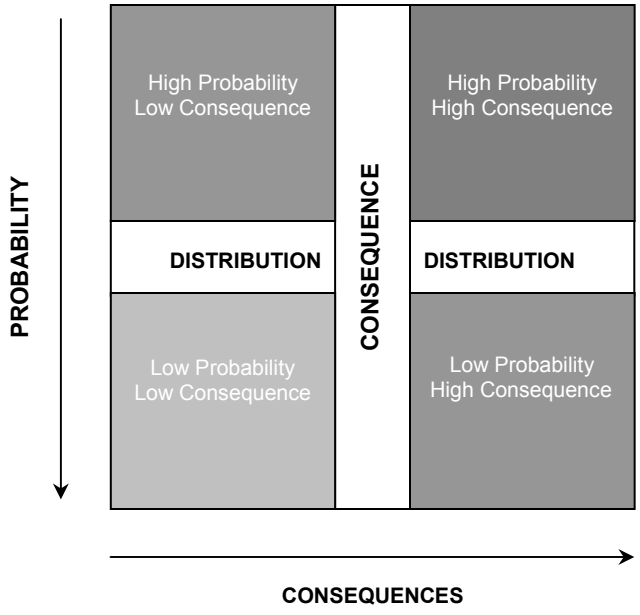
determined by response time performance, transportation network, population, topography, construction and occupancy character, density, and the relative risk level of a particular neighborhood or area.

- **Community Profile** – an analysis of the attributes of the community based on the unique mixture of demographics, socioeconomic factors, occupancy risk, demand zones, historical trends and level of service currently being provided.

Risk-Based Response Matrix

The risk-based response matrix below (Figure 4.1) is representative of the considerations of risk assessment for Lynchburg. There is always a probability of an event occurring. That frequency ranges from low to high. There are always consequences of that event, and that ranges from low to high. Each creates different requirements in the community for commitment of resources.

Figure 4.1 **Risk-Based Response Matrix**



Each quadrant shows the probability of occurrence and the consequence of occurrence for each event included in the risk assessment. This defines four possible relationships between structures or conditions and the distribution and concentration of resources:

- Low probability, low consequences

- Low probability, high consequences
- High probability, low consequences
- High probability, high consequences

Each quadrant of the chart therefore creates different requirements in the community for the commitment of resources. Fire departments must have a *distribution* of resources to be able to reach a very large number of events, regardless of how insignificant they are, over most of the jurisdiction it protects. This is an equity issue between neighborhoods. For example, low-income neighborhoods should not have any less protection than high-income neighborhoods, and high-income neighborhoods should not have any better level of service than low income ones. This concept is reflected in the distribution of fire companies to assure a specific response time performance goal for a certain fractile of the calls for service. In a perfect world, 100 percent of the community would have a fire company on scene within the response travel time goal. In the real world the distribution of fire companies is very good if the fire companies can arrive at least 90 percent of the time within the stated time goal.

Concentration is a risk/cost issue and both of these factors are variables; therefore **increased risk equals increased concentration**. Concentration is the ability to place enough resources on any specific risk to keep the event from becoming a major emergency. Fire stations and apparatus must be equally distributed in the community to provide an initial fire attack service to all areas. Conversely, the fire station locations and staffing patterns must be aligned to respond to a worst-case scenario – to concentrate staffing and pumping capacity to handle a major event.

There are many factors that make up the risk level that demands concentration: the ability of occupants to take self-preserving actions, construction features, built-in fire protection, fire flow, nature of the occupancy or its contents. However, among the leading factors is the number of personnel needed to conduct the critical tasks necessary to contain the event.

While risk factors all have some common thread, the rationale of placing an occupancy within any risk assessment category is to assume the worst. Fire flow is one such factor used as a risk assessment criteria or requirement that is based

on defining the problem that will occur if the occupancy is totally involved, and therefore creates the maximum demand upon fire suppression resources.

A community risk assessment may include defining the inherent differences between a single-family dwelling, a multiple-family dwelling, a large industrial occupancy or commercial campus, and a high-rise residential or commercial structure, and then assigning each to a different quadrant of the risk-based response matrix. Fire stations and emergency resources may be distributed uniformly throughout the community to provide prompt initial response to all types of incidents, or resources may be concentrated in high-consequence areas to enable a large-scale response to an unlikely but high consequential event. Even when resources are distributed relatively evenly throughout the community, they may be deployed differently to different types of incidents, based on the response needs of each particular incident type, or in response to seasonal changes, special situations or events.

Building (Occupancy) Risk

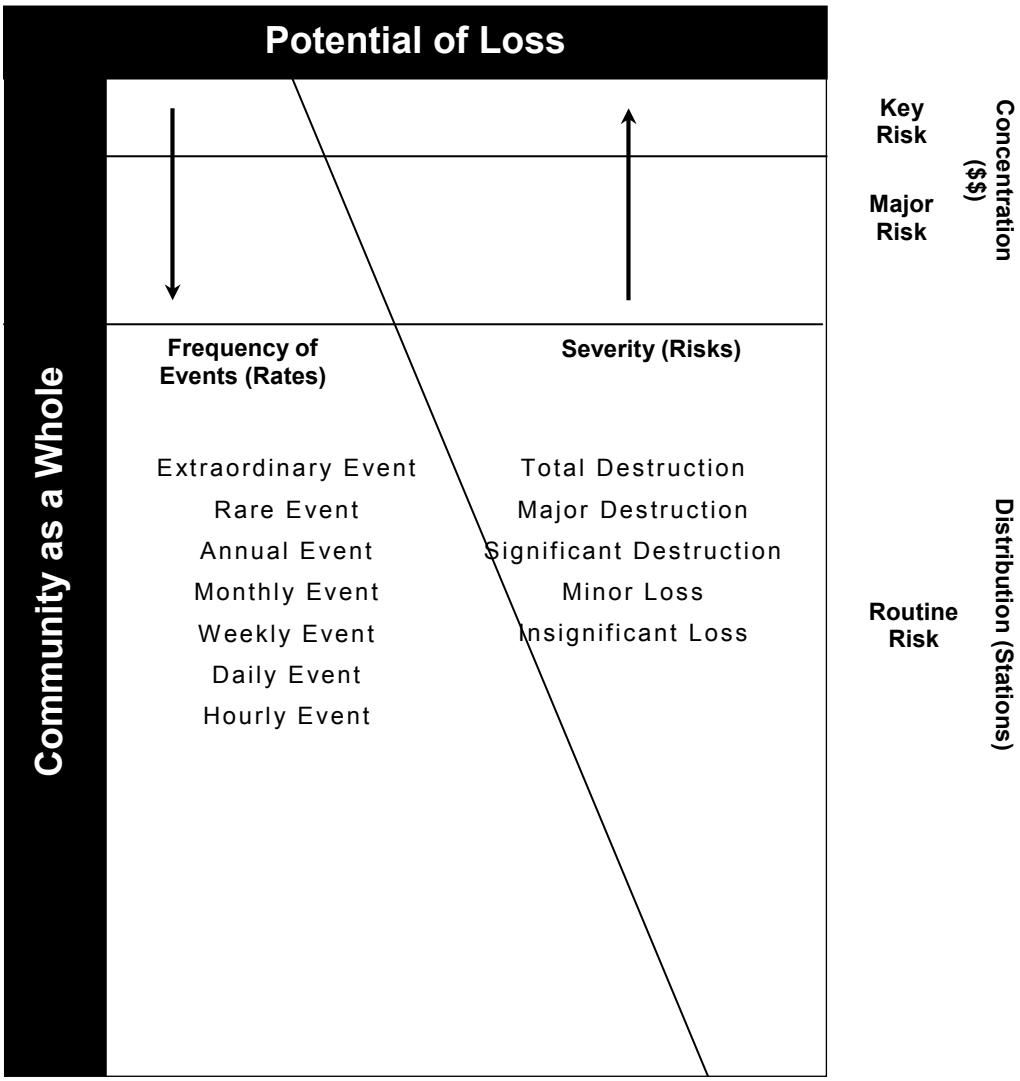
The fire flow concept of occupancy risk assessment addresses one of the most important aspects of fire control: the assessment of water supplies needed once a structure has become fully involved. The fire flow method does not address other equally important issues such as occupant risk and content vulnerability to fire origin.

Figure 4.2 provides a model that relates the various elements of risk to the relationship between the community as a whole, the frequency of events that occur, the severity of potential losses, and the usual distribution of risks. This chart demonstrates that the overall community may have a wide range of potential risks. If the community is like most communities there will be an inverse relationship between risk and frequency.

In short, the daily event is usually the routine or remote risk category. As demonstrated in Figure 4.2, the higher the risk level, the less frequency there is of the events occurring. If the risk management system is working properly in the community, a catastrophic loss should be an extraordinary event. In most communities the majority of losses occur in the smallest percentage of emergencies that reach the significant, major, or total destruction loss ranges. The objective of risk assessment techniques is to limit truly serious loss to a very

unusual event in the community. This involves trying to keep routine emergencies from becoming serious loss situations.

Figure 4.2 **Risk-Frequency Matrix**



Objective risk is identified by evidenced-based research, data analysis, statistical information, and other material. *Subjective risk* is essentially interpretation of unclear data, non-expert perception, or anecdotal evidence.

LFD has conducted its risk assessment using both objective and subjective risk information. Through a methodical analysis of the risk dynamics present in a given community, a risk assessment makes it possible to develop logical resource deployment strategies to meet identified needs. The goal of the risk assessment

process is to determine the *probability* of an event occurring, as well as the *potential consequences* of that event. From this analysis, the department defines its *level of response* to these events.

The majority of fire service concerns should be directed toward the development of effective fire defense strategies for occupancies that fall into the high probability-high consequence category, while at the same time preparing to deal with low probability-high consequence events. As stated earlier, *distribution* of fire companies assures wide-spread initial attack resources, but *concentration of value* requires an *effective response force* that is matched to those risks.

Just as there are many different types of fire fighting agencies, there are also many different ways in which fire fighting apparatus is staffed. The term for this is crew configuration. Crew configuration consists of the determination of the number of people that will be on a piece of apparatus so that it can perform effectively and a statement of how that crew will be assigned to that apparatus when an event occurs.

The resources that are *available* to respond and the safe deployment of those resources are described later in Chapter 5, *Critical Task Capability*. This is a critical component of this SORC, because different communities may adopt dissimilar resource deployment plans for the same types of emergency event. These decisions are typically based on distribution of community resources, personnel, funding, existing infrastructure, geographic considerations, as well as a host of other factors.

When addressing the establishment of an *effective response force* later in this document, the information presented is predicated upon the level of service that the community or City Council desires to support. For example, some communities may accept that they are only able to safely fight residential structure fires in a “defensive” mode, thereby allowing for a smaller response force. When stated in a SORC document, there should be an implied understanding that this type of response is accepted in the community and by City Council. Consequently, a higher level of service may be provided in a similarly sized community that has elected to dedicate the funding necessary to assemble an adequate “offensive” firefighting force.

Again, through a methodical analysis of the risk dynamics present in a given community, a risk assessment makes it possible to develop logical resource deployment strategies to meet identified needs. The goal of the risk assessment process is to determine the *probability* of an event occurring, as well as the *potential consequences* of that event. From this analysis, the department defines its *levels of response* to these events.

Service Area Factors

There are approximately 33,000 fire departments in the United States. These departments are all of different sizes and compositions. The community size and scope often places demand upon the department with respect to community expectations. The descriptions of urban, suburban, and rural communities provided by CFAI most closely match Lynchburg with a *suburban* community.

Suburban communities are usually described as areas with mixed occupancy, having average to high density populations somewhere between 500 to 1,500 persons per square mile. There is a moderate number of buildings per square mile with gridded streets, and the existence of cul-de-sac and dead-end residential development and some gated communities. There is also a varying mixture of open space, green areas, mid-rise and low-rise buildings, and a minimal number of high-rise buildings. There is also industrial and commercial development within the community, including strip malls, *brand boxes*, such as fast-food restaurants and *big boxes*, such as Wal-mart, Target, and Lowes. The budget for such municipalities is generally moderate, unless there are areas of affluence with high assessed valuation and the budget is primarily based on property and sales tax revenues. The International City Managers Association (ICMA) lists these such communities in the 50,000 to 250,000 population category.

In addition to the traditional fire elements, establishment of response performance standards must include consideration of the topography and the transportation network over which emergency responders travel to address the demand for service, the nature of the emergency response activity, the patterns of future property development and population growth. Risk assessments must also consider the elements of risk that exist for non-fire related situations, such as emergency medical services, technical rescue and hazardous material services. It should further be noted that the quantification of risk could be either subjective or objective.

LFD serves the City of Lynchburg with a high concentration of resources close to its urban core, and with a lesser concentration of resources as the neighborhoods become more suburban in nature. This is in response to the high consequence areas, which could require significant resources. LFD response area includes twenty-eight different planning zones that include local neighborhood businesses, heavy industrial, high-density multi-family density, riverfront and central business districts, and single-family residences. The twenty-eight zones exist sporadically throughout the city with single family residential structures existing throughout almost all areas. Although the planning zones are widely dispersed, LFD can identify key areas of the city, such as the downtown business core, industrial zones, and well-established residential neighborhoods. LFD realizes the diverse mix of development includes many old buildings without the benefits of modern, fire resistive construction methods that meet current building codes.

Topography

Lynchburg is known as the "Hill City" because of the seven original communities built on the rolling terrain of the City. The downtown business district is, in fact, built on a steep incline with the James River at its base. The natural features of Lynchburg have a significant impact on the suitability of the land for development. The variable rock types underlying the City have formed the hills and steep ravines of the central city, the imposing Candlers Mountain along the City's southern border, and the foothills of the Blue Ridge Mountains, including the Reusens area along the northwest border. Those areas of the City that feature a highly dissected landscape of narrow ridges and steep-sided valleys can present a challenge to the supporting infrastructure of the City and also to developers. Some areas of the City are so steep that they remain wooded and in their relatively natural states even today. Of the almost 32,000 acres of land in the City, nearly 31 percent, or 10,000 acres, of the total land area inside the limits is identified as vacant. However, a large portion of the vacant land is affected by environmental constraints, such as the steep slopes, floodplains, or soils unsuitable for septic systems.

Water Supply

The City of Lynchburg has one of the oldest municipal water systems in the nation. The City has a complex water distribution system because of its hilly terrain. The City's primary source for its water supply is the Pedlar Reservoir and

watershed, located in neighboring Amherst County. The water system includes seven primary pressure zones with several additional small zones, two water treatment plants, nine water storage tanks, and several pump stations. The treatment plants have a combined rated capacity of 26 million gallons per day (mgd), but have an average daily production of 11.5 mgd.

The system provides adequate densities of fire hydrant availability throughout most of its service area; however, many "open spaces" and forested areas are without a piped water supply and water tankers must deliver it for fire suppression efforts.

Development and Population Growth

The City of Lynchburg grew rapidly during its early years as an important economic hub for Central Virginia. The City experienced steady population growth during the 19th and 20th centuries, except during the Civil War era, the national economic downturn of the 1890s, and World War I. After 1960, however, Lynchburg became a mature city, with periods of decreasing population then periods of dramatic increases primarily due to periodic land annexation.

The Central Virginia region has continued to grow, but the growth has shifted to surrounding counties of Amherst, Bedford, and Campbell with growth rates ranging from 1.4 percent to 13.8 percent during the first decade of the 21st century. During that same period, the City of Lynchburg population *increased* by 15.8 percent.

Table 4.1 **City of Lynchburg Population**

	1990*	2000	2010**	% change 2000-2010
City of Lynchburg	66,049	65,269	75,568	15.8%

Sources: *Weldon Cooper Center for Public Service

Nonetheless, the population density for Lynchburg equals slightly more than 1,503 people per square mile. Generally speaking, the lower the density, the lower every other factor tends to be, including the number of incidents, the values at risk and even resources available to support the department's financial needs.

While the figures above represent the permanent residential population of the city, Lynchburg is the dynamic hub for the region's business, commercial, industrial, cultural and social activities. The daytime population for the city grows to approximately 120,000. It's also very important to recognize the importance of the City's higher educational institutions, including Central Virginia Community College, Lynchburg College, Randolph's College, Virginia University at Lynchburg, Liberty University and a host of smaller technical and trade schools. However, the three residential institutions bring an additional 16,000 temporary residents to Lynchburg during the academic year. Of additional significance is the expected growth of Liberty's University residential population to 25,000 by the year 2015.

While the City's total population will remain stable over the next ten years, the number of elderly citizens (60 and over) will increase by approximately 25 percent when compared to the 2010 population for this same age group.[1]

Currently, 47% of the department's emergency medical services are provided to the elderly segment of the City's population, and 27% of the calls for service from the elderly are of an advanced life support nature. As a result of the "aging" population of Lynchburg, the department should experience an increase in emergency medical calls for service, with most of the growth in the elderly (60+) age category.

In addition to the current development in the "planned community" of Wyndhurst and Cornerstone, the City's Comprehensive Plan also designates the areas of Boonsboro Road (at Cheese Creek Road) and Tyreeanna for this type of development (all on the periphery of the City). Developments of this nature often attract a considerable number of elderly residents. [2]

Planning is also underway for the City's "Mid-Town", which includes the areas around Miller Park, The Plaza, EC Glass High School, Lynchburg General Hospital, and Lynchburg College. Re-development and renovation of this area of the City would also increase property values and may result in population count changes.

[1] *Lynchburg 2015*, Lynchburg Fire & EMS Department, July 2005.
[2] *City of Lynchburg Comprehensive Plan 2002-2020*, Lynchburg Department of Community Planning & Development, September 2002.

Aging neighborhoods in some areas of the inner City, and in the West End, Fort Hill, and Sandusky areas, may result in increased requests for fire suppression and EMS responses due to a lack of fiscal resources on the part of residents to properly maintain houses and to obtain preventative medical care. Much of the property in these areas is also rental property.

Undeveloped areas on the fringes of the City (Boonsboro Road/Route 501 Bypass, Timberlake Road, Graves Mill Road, Tyreeanna areas), are very likely to generate a considerable amount of residential housing construction and a resulting population shift. The downtown area of the City is now experiencing (and will continue to experience) considerable development and rehabilitation of former commercial/industrial property for residential use. Such construction often increases the potential for fire and for more substantial damage as a result of fire than would normally be the case in new residential construction. Much of the new residential construction (and thus increased population) occurring over the past 5 years has been concentrated in the old Wooldridge Farm area of Greenview Drive (Cornerstone), Wyndhurst, and the US Route 501 corridor from Graves Mill Road north to the City limits.

Political factors, some beyond the direct control of area public safety agencies, can have considerable impact on how well, and to what degree jurisdictions and public safety organizations participate in joint regional ventures. Cultural differences and biases between career and volunteer public safety agencies can have a considerable negative impact on agency interaction if efforts to minimize such problems aren't addressed in a comprehensive, timely manner.

Increasing county populations, call volumes and legislative mandates may be the impetuses that eventually lead to counties supplementing volunteer workers with paid personnel, and subsequently to joint cooperative ventures such as regional purchasing and grant activities.

Transportation System and Networks

The City of Lynchburg lies at a significant crossroads of major traffic corridors within the Commonwealth of Virginia. Primary highways to the City include US Route 29, US Route 460 and US Route 501. Historically, these traffic conditions have been focused on routing traffic through the City rather than around it. Such

traffic patterns and trends can have profound impact on neighborhoods, access corridors, and the economic vitality of the City. [3]

The City's Public Works Department maintains 853 lane miles of roadway, 315 lane miles of shoulders, and 175 miles of sidewalks.[4] Although improvements to roadways primarily address capacity, safety, or efficiency issues, they are also an opportunity to create roadways that are of quality design. The City's planning department encourages the development of a Transportation Master Plan (TMP), to include design elements such as on-street parking , landscaping, medians, traffic calming measures, narrower lanes, sidewalks, and other features as appropriate. It will be imperative that the LFD becomes involved in the development and/or review of the proposed TMP.

Type of Calls to Which the Department Responds

Over the past three calendar years, LFD has responded to an average of approximately 14,500 incidents. The incidents are classified into the following categories:

- Fires
- EMS – Emergency
- EMS – Non-emergency
- Hazardous Materials Incidents
- Technical Rescue (includes a variety of specialized rescue scenarios)
- Mutual Aid

The Table 4.2 shows the total incident frequency for Lynchburg Fire & EMS Department from January 2008 – December 2010.

[3] *City of Lynchburg Comprehensive Plan 2002-2020*, Lynchburg Department of Community Planning & Development, September 2002.
[4] City of Lynchburg Public Works website, March 17, 2005.

Table 4.2 **Frequency of All Calls: 2008 – 2010**

Risk Category	2008	2009	2010	Total
Fire				
Structure	388	305	315	1,008
Auto	94	98	86	278
Brush	67	77	83	227
Trash	14	10	9	33
Explosion	5	4	2	11
Transportation	1	2	1	4
Miscellaneous	238	220	210	668
Fire Alarms	1,271	1,095	1,097	3,463
Sub-total	2,078	1,811	1,803	5,692
EMS: Emergency				
Emergent	7,527	7,618	7,999	23,144
Urgent	4,475	4,432	4,845	13,752
Sub-total	12,002	12,050	12,844	36,896
EMS: Non-Emergency				
Public assist	92	88	98	278
Transport only	2,898	3,035	2,318	8,251
Sub-total	2,990	3,123	2,416	8,529
Other				
Hazardous Materials	213	236	224	673
Technical Rescue	155	167	257	579
Mutual Aid				
All Mutual Aid	93	68	71	232
Total	19,040	18,770	18,922	52,601
Average per Day	52	51	52	52
Response Every X Minutes	0:52	0:51	0:51	0:51

In analyzing each type of incident, LFD looked at the frequency of incidents over time, as well as a temporal analysis of aggregate data, to determine the demand patterns for response services at various times of the day. Again, data from calendar years 2008, 2009, and 2010 were used in this analysis. Tables and graphs further detailing Table 4.2 appears later in this chapter and in Chapter 6, *Service Level Objectives.*

General Risk Evaluation

It is necessary for each community to assess the risk by a method that is measurable, if there is to be any commonality among risk-based deployment models. Many fire departments classify risks according to a graded system, which uses defined terms such as “maximum risk,” “significant risk,” “moderate risk” and “low risk” to classify portions of the areas they protect, and to develop

response programming based on those classifications. This, too, is the case with LFD as it has taken a more comprehensive look at risks in order to establish response capability objectives and deployment standards.

LFD utilizes a software program called **Risk, Hazard And Value Evaluation (RHAVE)**[5] to provide an accurate and current description of the values-at-risk in the community. Values-at-risk (VAR) is the inventory of a community's potential fire problems arrayed from the most valuable and vulnerable risk to the least valuable and vulnerable risk that the fire protection agency is deployed to protect. RHAVE assumes the existence of five factors:

- building
- life safety
- water demand
- values
- risk range

The data from these five factors are used to develop an occupancy vulnerability assessment profile (OVAP). The benefits of using such a standardized calculation tool such as RHAVE to identify risks are twofold. First, with all areas of the city scored, LFD can ascertain that locations presenting a higher-than-average risk are properly represented in the department's response schedule. Second, the spacing of fire stations for multiple company response (concentration) takes into account only higher risk areas, thus pulling only some of the city's fire stations closer together for higher risks. Thus some economic sensitivity is gained: in typical or low-risk areas, fire station spacing can be spread out a little further.

The fact is, if needed personnel and equipment arrive too late, the fire will grow beyond the ability of the initial assignment to stop the fire's spread. The incident then grows to multiple alarms, draining the community's resources. The balancing act is to have a deployment plan that inhibits the occurrence of multi-alarm fires.

Over the long term, the goal for a RHAVE assessment is to have fire department personnel produce a RHAVE score for each building type in the city. Because the initial study had a tight time frame and a computer database was not readily

[5] In the development of the standards of response coverage concept the Commission on Fire Accreditation International, Inc. worked with the U.S. Fire Administration to create RHAVE. In cooperation with the USFA, CFAI developed this standardized risk assessment methodology to assess fire risk in a community based upon local input.

available, RHAVE scoring of sample areas of the city was performed – and is acceptable by CFAI.

Once the data elements were entered into the RHAVE program, a score for each building was calculated. These scores are then banded into groups. This is necessary because realistically we can only vary development across a few group types. It would be impossible to locate fire stations to cover dozens of different risk types. Also, by grouping like risk types, communities can have a standardized viewpoint of risk, while having slightly different types of buildings within each band.

The RHAVE categories are:

- **Maximum** Risk: OVAP Score of 60+
- **Significant** Risk: OVAP Score of 40 – 59
- **Moderate** Risk: OVAP Score of 15 – 39
  (Also known as typical or average)
- **Low** Risk: OVAP Score of < 15

In general, it is not appropriate for the risk assessment model to include more than four RHAVE categories plus any special risks. These may be defined by using either the term offered by the RHAVE process for buildings and/or by other specialty risk assessment systems in the fields of EMS or wildland fire fighting.

Objective Risks

LFD used the RHAVE process to stratify risk into more definitive categories and determine the values exposed to loss, the probability of an event occurring, and the consequences that such an event may have on the community. LFD believes primary risk falls into four general categories in order of severity: life risk, community economic risk, environmental or historical risk and pure dollar loss. All of these risk types exist in LFD's response area. Examples of the risk types are described below:

- Life Risk: Any location that presents a high risk of life loss, such as high density housing (particularly unsprinklered and older structures), foster care homes, skilled nursing facilities, hospitals, housing within close proximity to hazardous manufacturing or storage, day-care centers, and schools.

- Community Economic Risk: Those facilities that have a high dollar value, and if destroyed or damaged by fire could close or relocate, permanently or temporarily placing a severe economic burden on the community through the loss of jobs and/or tax revenue. This category also includes critical infrastructure of primary importance to the economic health and safety of the community, such as utilities, roads, and bridges.

- Environmental or Historical Risk: Any area where a high risk of severe or permanent environmental damage would likely occur in the event of a fire loss or hazardous material spill, or any structure of significant historical significance to the community.

- Pure Dollar Loss: Structures that have a high value but pose a low risk of life loss or community economic impact and are typically fully insured against loss. Examples include large rural residential and farm structures, and some commercial buildings housing primarily inventory.

LFD completed the initial RHAVE study in March of 2003, and found that a substantial amount of information about occupancies is not currently being collected in the field by inspectors or fire fighters. As a result, the following methodology was utilized to conduct the RHAVE evaluation:

- A list of all structures in the City that are classified by the City of Lynchburg Assessor's Office was assembled.
- The structures were grouped together based upon a grid system into 300 "tiles." This same "tile" system is utilized throughout the Commonwealth of Virginia utilizing points that are fixed and that should never be changed.
- Utilizing the tiles and property information from the Assessor's Office, a common structure type for each tile was established and any anomalies for each tile were also noted.
- The common structure type and the anomalies in each tile were surveyed utilizing the RHAVE method, with a sampling of 250 structures actually being visited.
- The data collected in the field was reviewed for accuracy and then entered into the RHAVE software program. The representative scores determined whether additional surveys needed to be completed on particular property

types, particular areas of the City or any other trend that could be established from the data.
- The RHAVE scores, together with the tile gridding system allowed for the correlation of information for the risk assessment.

LFD made many assumptions about the buildings it serves based on the limited amount of information available. Some of those assumptions included:
- That there is little variation in the risk assessment of single-family dwellings in the City of Lynchburg. Other localities experience a significant variable in these scores due to travel time, water supply and other factors that are not applicable in Lynchburg.
- Conceding that all areas of the City will have sufficient water resources to extinguish a fire in its incipient phase, unless an area is known to the officers to be of concern. For those areas, fire flow tests were conducted, additional data was obtained from the Utilities Division of Public Works or the low water score was accepted for a particular areas. There were only a couple of instances involving insufficient water availability in commercial districts.
- Like-type, size, and use structures will have like RHAVE scores, unless local knowledge indicated otherwise. For example, there is not much difference in an incipient fire in a 120,000 square foot Wal-Mart store and a 100,000 square foot Target store, all things being equal. An additional area where this methodology was utilized was along Main, Church, and Commerce Streets from Fifth to Twelfth Streets.

LFD will work to establish a mechanism for collecting more complete information about buildings and occupancies, including the continuation of pre-incident planning, and collection of RHAVE data, on an on-going basis.

Occupancies

LFD learns about the buildings and occupancies it serves through its pre-incident planning activities, its code enforcement program, and its involvement with the Department of Planning and Community Development's Technical Review Committee (TRC). The Fire Marshal's Office is in the process of developing a field inspector program that will increase the number of NFPA 1301-certified inspectors within the department. This will allow additional occupancies to be inspected on a more frequent basis.

LFD has defined the dispersion of occupancies throughout its jurisdiction to understand the types and sizes of occupancies it protects. This information along with other occupancy information is critical in determining deployment levels of fire companies. Information gathered for this document was provided through the department's field personnel collecting information on specific occupancies, the City of Lynchburg Assessor's Office and the Building Commissioner's Office. While LFD has not yet completed gathering of occupancy information, future programming through the Fire Marshal's Office should increase the use of information technology by department personnel in collecting and maintaining occupancy-related statistics. Such information should include very specific details, such as building size, height, type of construction, building separation, type of installed fire protection systems, and other factors.

LFD has defined the risk protection categories as follows:

- **Low Risk**: Areas may be classified as low risk if they are isolated from any centers of population and contain few buildings. Areas of low risk might include:
    - Rural land with no occupied structures
    - Recreational areas (Federal, State, and local parks)
    - Small commercial structures that are remote from other buildings
    - Detached residential garages, out buildings and storage sheds.

  Typical call types for a low risk area include automobile fires, small shed, dumpster fires, carbon monoxide detection calls, grass and low fuel type fires.

- **Moderate Risk**: Areas may be classified as moderate risk if they are in a built-up area of average size. The risk of life loss or property damage from fire in single-family dwellings is usually limited to the occupants, although in certain areas, such as small apartment complexes, the risk of death or injury may be relatively high. Concentration of property may vary, but it will generally be limited. Examples of moderate risk areas might include:
    - Developments consisting generally of detached, single-family housing, including estates and smaller multi-story dwellings

- Areas of older, attached multi-family two-story dwellings, with the predominance of the property accessible to pre-connected attack lines
- Areas of suburban, terraced, semi-detached, multi-occupancy residential properties
- Mixed low-risk industrial and residential areas
- Industrial or commercial areas of less than 10,000 square feet without high-hazard or high fire-load contents
- Railroad facilities
- Mobile homes
- Aircraft on airport property

- **Significant Risk**: Areas may be classified as significant risk if they contain continuously built-up areas of substantial size with a predominate concentration of property presenting a substantial risk of life loss, a severe financial impact on the community, or unusual potential damage to property in the event of fire. Examples of such areas might include:
  - Mercantile facilities, strip shopping centers, and business areas consisting of either single- or multi-story properties offering some degree of concentration
  - Concentration of hospital and medical facilities
  - Concentrations of older multi-story property offering substantial amounts of exposure to life loss potential
  - Apartment buildings more than two stories in height with areas beyond the reach of pre-connected hose lines
  - Buildings with low occupant load, but which store high fire load materials or high-hazard materials
  - Infrastructure facilities, such as city hall, fire and police stations, schools and City, State or Federal facilities
  - Industrial areas containing some high-risk occupancies
  - Aircraft off of airport property

- **Maximum Risk**: Areas may be of maximum risk if they are of substantial size and contain a predominant concentration of properties presenting a high risk of life loss, loss of economic values to the community, or large loss damage to property in the event of fire. Maximum risk problems ordinarily would be highest fire flow areas. Normally, these structures lack

built-in fire protection features and/or contain occupants not capable of self-preservation.

These risks frequently heighten a fire department's need to have multiple alarm capabilities, and adequate assessments of its ability to concentrate resources. Failure to identify these risks often, adversely impacts a department's inability to control the loss once a fire has occurred. These risks also create a fundamental need to conduct an assessment of mutual and automatic aid requirements to support the department's operations. Examples of maximum risks might include:

- Main shopping and business centers, large department stores, shopping malls, multi-story hotels, and office properties
- Concentrations of theaters, cinemas, clubs, dance halls, and other entertainment centers
- Concentrations of high-risk industrial or commercial property
- High-rise buildings, especially those without built-in fire suppression systems
- Commercial buildings of more than 10,000 square feet with occupants who may require exiting assistance
- Buildings with built-in fire suppression, but whose occupants are non-ambulatory or restrained (hospitals or prisons)

Tables 4.3 and 4.4 illustrate the challenges that each of the LFD eight stations face.

Table 4.3 **Category of Risk by Station Response Areas**

Station	Low	Moderate	Significant	Maximum	Total
#1, Clay Street	825	2,898	212	2	3,938
#2, Grace Street	806	2,906	167	0	3,879
#3, Fort Hill	1,043	2,080	243	0	3,367
#4, Rivermont	575	1,785	109	1	2,469
#5, Boonsboro	318	996	107	0	1,420
#6, Miller Park	973	3,630	116	1	4,719
#7, Lakeside Drive	1,103	2,710	189	0	9,003
#8, Graves Mill	155	799	41	1	996

Total	5,798	22,805	1,183	5	29,791

Table 4.3 organizes the parcels of property within the City by risk type and by station. As shown in the table, 22,805 parcels represent the largest risk category, that being moderate risk. There are 5,798 parcels comprise the low risk category, while there are 1,183 significant risks in the response areas. Most of these significant risks consist of large commercial structures utilized for industrial type processes or large residential properties, many of which provide housing for the elderly. There are only five maximum risk facilities within the City of Lynchburg. These include The Virginian Apartments (718 Church Street), the Bank of the James building (828 Main Street), Lynchburg General Hospital, Virginia Baptist Hospital, and The Summit residential facility/nursing home in Wyndhurst.

A more detailed table organized by response zone is included in Appendix 2 of this document.

Figure 4.1 represents a graphic illustration of the category of risk by station response area.

Figure 4.1 **Risk Type By Station Response Area**

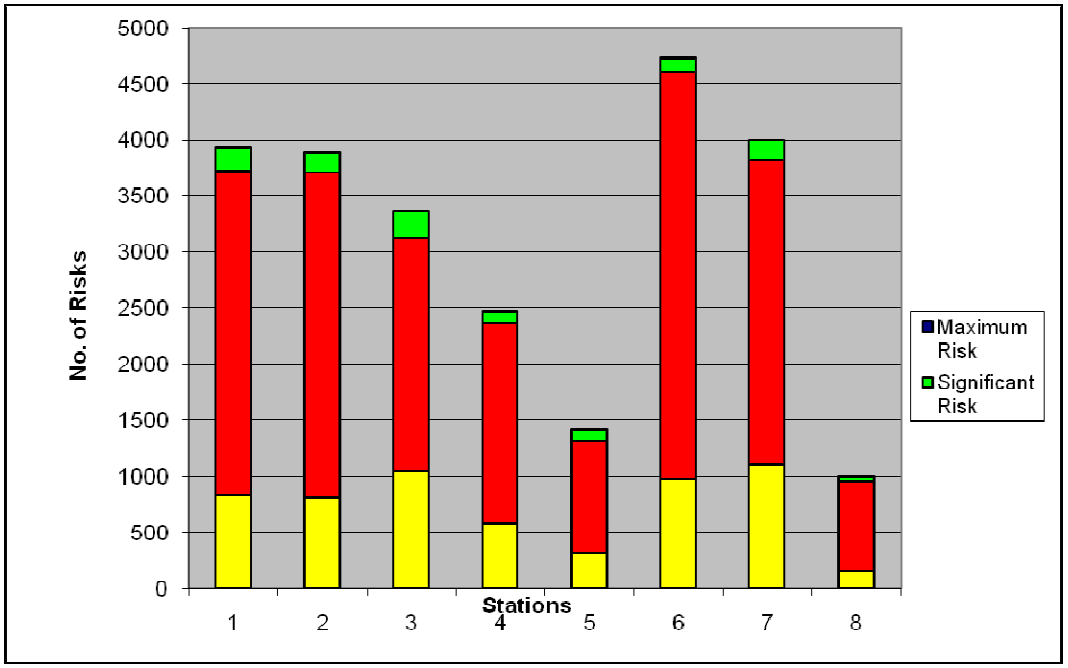


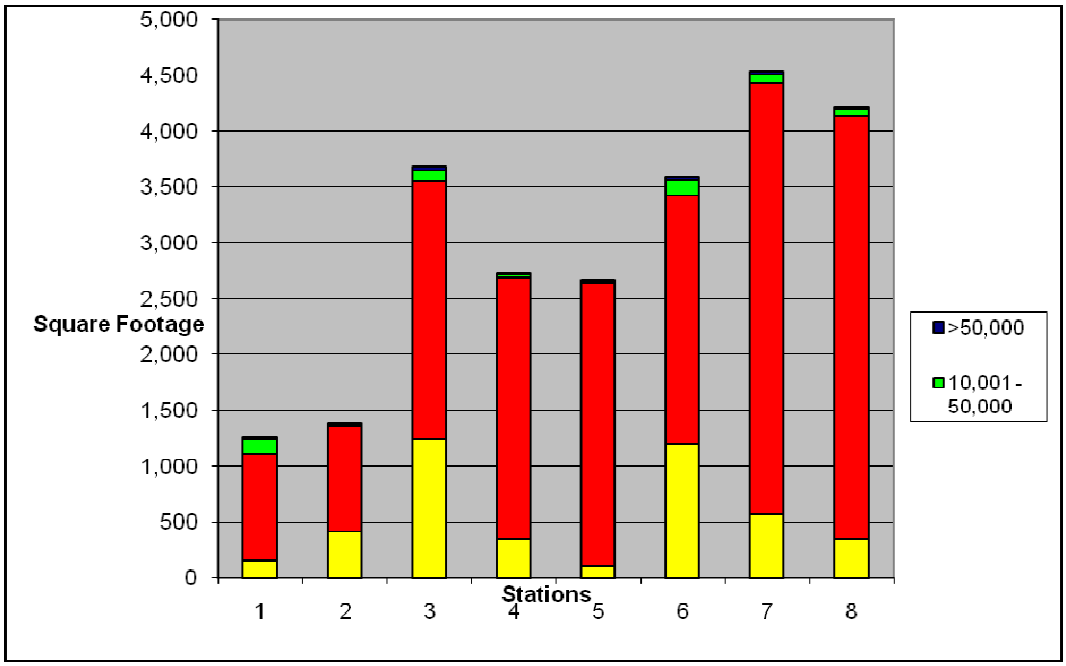
Table 4.4 illustrates the size of occupancies as dispersed among the eight fire station response areas. This shows that nearly 79 percent of the occupancies are at least 1,000 square feet large, but not larger than 10,000 square feet. Less than 1 percent of all occupancies in Lynchburg are greater than 50,000. However, fire loss in one of these structures would have a greater impact on the community than the fire loss associated with most occupancies that are less than 10,000 square feet. This is the simply because the larger structures have a higher impact on tax revenues generated than the smaller structures. The smaller structures can also be more easily rebuilt following a fire.

Table 4.4 **Size of Buildings by Station Response Area (in square footage)**

Station	< 1,000	1,001 - 10,000	10,001 - 50,000	> 50,000	Total
#1, Clay Street	150	960	124	19	1,254
#2, Grace Street	412	950	13	5	1,381
#3, Fort Hill	1,23	2,320	90	37	3,680
#4, Rivermont	346	2,341	29	4	2,720
#5, Boonsboro	105	2,537	15	1	2,658
#6, Miller Park	1,195	2,232	129	29	3,585
#7, Lakeside Drive	568	3,861	81	25	4,534
#8, Graves Mill	341	3,793	64	19	4,217
Total	4,350	18,995	545	140	24,029

The graphic illustration below demonstrates the size of the occupancies by station response area.

Figure 4.2 **Size of Structures By Station Response Area**



Subjective Risks

Subjective risks are defined by interpreting unclear data, non-expert perception, or anecdotal evidence. LFD combines this method with the knowledge of fire companies in the field to further assess risk. Fire companies' knowledge is considered "expert," as they have significant experience with and understanding of the buildings they serve to protect.

LFD conducts pre-incident planning to identify and analyze fire company target hazards for emergency response purposes. The department considers target hazards as buildings/occupancies in which any of the following exists:

- Potential for large loss of life
- Potential for large property loss
- Potential for large economic impact to the community
- Strain LFD's resources to control an emergency
- Hazardous materials within building
- Any structure that presents higher than average risk to structural firefighting or rescue operations

- Structures having historical or irreplaceable cultural significance
- Structures containing irreplaceable court or property records or works of art.

A map showing the Tier II reporting facilities and target hazards in LFD's jurisdiction can be found in the *Appendix 2* chapter of this document. Fire companies conduct pre-fire planning within each fire response area. For each target building or occupancy, the fire company prepares a pre-fire RHAVE survey form. This process ensures proper documentation of all target hazards and lets fire companies become better acquainted with the intricacies of buildings that pose complex fire response concerns or high-risk/high loss situations. The data collected is then entered into the "Premise Data" module of the LFD information management database.

LFD believes pre-incident planning is an effective and proactive way to assess and educate itself about the community it serves. Responding companies have the capability for pre-incident viewing of occupancy information that has been collected and entered through the "Premise Data" module from the mobile data computers (MDC) on all fire apparatus.

Probability

The probability of a fire event occurring in a particular property, and the consequences of that event can be further determined by evaluating historical data. Unfortunately, LFD has done a very poor job of collecting data on estimated fire loss. Therefore, an illustration demonstrating the historical data for the probability and consequence of fires occurring in a particular structure is not available.

LFD will use available information to guide the development of response standards for residential properties. With this in mind, the dollar-loss factor becomes a common comparison among all properties. Any adopted risk levels and standard of response coverage must assume that residential property fire is a highly probable event, and mercantile, basic industry and unclassified properties are high consequence events. In addition, LFD must consider other types of occupancies, such as vacant buildings. These structures have low probability, but high consequence. LFD must maintain resources for these events when considering the acceptable level of community risk.

EMS Risk Assessment

As in assessing risks associated with fire, it is imperative to perform a risk assessment for emergency medical needs and the impact of illnesses and sudden injuries. While the concept of risk assessment has been the topic of a variety of fire programs in the past, i.e. pre-fire planning and fire flow, the study of risk for EMS is a much more limited area of study. Yet, with 85 percent of the call workload, EMS responsibilities are becoming the norm.

One EMS goal, consistent with medical literature, is reducing response times to time-sensitive medical emergencies – such as cardiac arrest. However, achieving this goal will require innovative strategies. One strategy is to determine if clusters, specific areas, or areas/populations within a community experience greater numbers or higher percentages of time-sensitive medical conditions.

While quantification of the value of shorter response times to all medical conditions is not possible, it is possible to quantify this correlation between time-sensitive chief complaints and community characteristics. For example, communities with older populations are more likely to experience a greater number of heart attacks or cardiac arrests. By pinpointing neighborhoods with more frequent occurrences of specific medical emergencies, the department can organize its resources to respond more effectively to those medical conditions that benefit the most from rapid intervention.

While cardiac arrest and choking are the most time-sensitive medical emergencies, there are other emergencies that can benefit from shorter response times. While admittedly there is little in the medical literature describing optimal time-to-treatment intervals, pathology of disease processes supports the hypothesis that shorter intervention times improve outcomes.

Types and Frequency of Calls

Detailed incident information is maintained through a fire and EMS reporting system called Visual Fire Info. For each call for service, an incident report is created utilizing this software. The reporting system utilizes information that is derived directly from the computer-aided dispatching databases utilized by the Emergency Communications Center. Unfortunately, there have been administrative procedural changes within the past two years that have changed

which responding units complete incident reports.[6] However, for the purposes of this analysis, a combination of data was obtained from the Visual Fire Info databases and the computer-aided dispatching databases were utilized. LFD analyzed incident types and frequencies to assess the probability of a particular event taking place. All calls for service over the past three calendar years have been included. The results are shown on the following pages. LFD examined a total of seven categories: fire, EMS – emergency (emergent and urgent), EMS – non-emergency (public assistance and transport only), hazardous materials, technical rescue, and mutual aid.

To show call-type frequency by time of day, this document also includes a temporal analysis of aggregated data to demonstrate the peak load demands for response services. This data makes a convincing case for some departure from traditional fire department scheduling and static resource deployment; however, LFD has not implemented such deployment activities.

Fire Incidents

The Table 4.5 summarizes fire incidents by type, total number of fire responses annually, and the daily (24-hour) average for each year. These were calculated using the call types utilized by the National Fire Incident Report System Software (NFIRS). A limitation of this system is that it utilizes call types as determined by the incident reporter and does not take into consideration the call type that was received by the dispatcher which in some cases may differ from the nature of the call specified by responding fire and EMS personnel.

Table 4.5 **Frequency of Fire Incidents, 2008-2010**

Type of Fire Incidents	2008	2009	2010	Total
Structure	388	305	315	1,009
Auto	94	98	86	278
Brush	67	77	83	226
Trash	14	10	9	33
Explosion	5	4	2	11
Transportation	1	2	1	4

[6] An administrative decision was made that effectively did not require an engine company to complete a NFIRS report for an EMS call for service and did not require a medic unit to complete an EMS report for a fire-related call for service because the "responding unit" information, including total reflex times were captured on the report that was being generated. However, this resulted in an under-reporting of engine company responses to EMS calls for service and an under-reporting of medic unit responses to fire-related calls for service to their respective federal (where applicable) and state agencies collecting such data. This administrative decision was later reversed to correct this problem.

Fire Alarms	1,271	1,095	1,097	3,463
Miscellaneous	280	350	324	954
Total	2,121	1,941	1,917	5,979
Daily Average	5.8	5.3	5.3	

As seen in the above table, fire-related incidents are a daily event throughout LFDs' service area. Approximately 16 percent are automobile, brush, trash/rubbish, explosion and transportation-related. Nearly 28 percent of fires are structure-related fires, but when considering the potential that each fire alarm is a potential structure fire, 60 percent of all fire incidents are structure fire-related.

LFD has tried to define the term "working" structure fire to help determine resource commitments; however, present data collection does not allow for the analysis of when an incident has been "downgraded" (where the incident is under control and no more resources are needed other than those already on the scene).

Table 4.6 **Confinement of Fire Spread, 2002-2004**

Fire Area	2002	2003	2004	Total
Object of Origin	14%	15%	17%	15%
Room of Origin	60%	59%	60%	60%
Floor of Origin	21%	20%	16%	19%
Structure of Origin	5%	5%	5%	5%
Beyond Structure Of Origin	0%	1%	2%	1%

LFD has been able to analyze the ability to confine a fire. The department is able to confine the fire to the room of origin 60 percent of the time in all structural and mobile-fixed fires. The LFD has a low incidence (1 percent) of fire spread to structures or properties beyond the structure of origin. This indicates that LFD is successful in containing the fires to the structure of origin and minimizing fire loss to adjacent structures.

Automatic Fire Alarms

Automatic fire alarms are included here because they necessitate an emergency response. The emergency communications center dispatches responses based on three different levels of fire alarms:

- Level 1: Residential fire alarms that initiate a response by the first due Engine Company only.
- Level 2: Commercial fire alarms that initiate a response by the first due engine and truck companies only.
- Level 3: Any type of fire alarm where the presence of fire is confirmed by the caller. This type of fire alarm necessitates a "full response" of fire apparatus.

Statistically, nearly all automatic fire alarms are false alarms. Consequently, many of these calls result in a "disregard" or cancellation of the responding unit(s) while still enroute, when a responsible party confirms that there is no fire and no response is needed. These calls generally consist of alarm system activations where the system malfunctioned, was inadvertently activated, or was being worked on and the notification system failed. If the situation was determined to be a structure fire or there was another legitimate reason for the alarm, such as smoke, the call would typically be recorded in one of the other incident categories when a fire incident report is completed; however, it continues to be recorded by the emergency communications center as a "Fire Alarm – Level 3."

The following table shows the number of automatic fire alarms, including those where no fire or damage occurred, and those where there was damage of some form (e.g., water from sprinkler system malfunction, smoke from small fire that had been extinguished by worker prior to our arrival, overheated or shorted electrical equipment, etc.)

Table 4.7 **Frequency of Fire Alarms: 2002-2004**

Fire Alarms	2008	2009	2010	Total	Yearly Average
Total	1,271	1,095	1,097	3,463	1,154
Arrived	892	734	786	2,412	804
Cancelled Enroute	379	361	311	1,051	350
Fire Alarms Daily Average	3	3	3	2,309	

EMS Incidents

The majority of LFD incidents are medical in nature. The department breaks its EMS incidents into two categories: emergency and non-emergency. Emergency calls for service are considered to be those where someone calls 911 for an immediate response. Within this category there are advanced life support calls for service (emergent) and basic life support calls for service (urgent). Non-emergency calls for service are considered to be those where either an individual needs assistance but is not sick or injured (such as assisting someone off the floor who has fallen but is not injured) or where arrangements are made in advance or where a medically-trained individual identifies to the dispatcher that the request is "non-emergent" and the patient needs only to be transported (usually interfacility). These *transport only* calls for service are answered primarily by a designated non-emergency transport unit[7] and by any other available medic unit, based on emergency service requests.[8] The *public assistance* calls are primarily answered by the first due engine company due to their close proximities and to keep the busier medic units available for emergency calls for service.

The department currently responds to approximately 34 emergency and 8 non-emergency calls each 24-hour day. Today, seven of the eight staffed engine companies are assigned at least one advanced life support provider and are equipped with a complete inventory of advanced life support equipment, providing the City with greater ALS first response capabilities.

Table 4.8 **Frequency of EMS Incidents: 2002-2004**

Type	2008	2009	2010	Total	%
Emergency					
Emergent	7,527	7,618	7,999	23,144	50.9%
Urgent	4,475	4,432	4,845	13,752	30.3%
Sub-total	12,002	12,050	12,844	36,896	81.2%
Non-Emergency					
Public assist	92	88	98	278	0.6%
Transport only	2,898	3,035	2,318	8,251	18.2%
Sub-total	2,990	3,123	2,416	8,529	18.8%
Annual Total	14,992	15,173	15,260	45,425	100.0%
Daily Average	41.1	41.6	41.8	41.5	

[7] The designated non-emergency transport unit is staffed Monday through Friday for an eight-hour shift. The unit is out of service on official City holidays.

[8] If demand for non-emergency transports increases to the point where there is a significant "stacking" of transports, a reserve medic unit may be placed in service at the discretion of a Battalion Chief (and subsequently, an engine company placed out of service) until the number of "stacked" transports is back to "normal."

As seen in the above table, there are approximately 42 EMS calls for service daily and over 15,000 annually. This figure represents a “readiness” measure, as initial call type codes (not situation found) were used to generate the above table and the one below.

Table 4.9 **Frequency of EMS Incidents (by call type): 2008-2010**

Emergency				
Emergent				
Accident PI	610	661	613	1,884
Allergic Reaction	155	157	143	455
Assault	216	173	186	575
Severe Bleeding	409	472	503	1,384
Breathing Problems	1,425	1,414	1,398	4,237
Burns	18	22	13	53
CO Inhalation	4	1	2	7
Chest Pain	919	938	1,040	2,897
Choking	57	62	73	192
Sudden Death	40	41	52	133
Drowning (Near)/Diving	2	1	2	5
Electrocution	2	7	5	14
Faint/Unconscious	928	909	903	2,740
Fall - Serious	1,154	1,186	1,314	3,654
Heart Problem	377	376	428	1,181
Hit and Run - PI	44	43	21	108
Malicious wounding	108	95	79	282
Pregnancy/Childbirth	161	153	187	501
Seizures	381	421	433	1,235
Stroke	250	236	310	796
Traumatic accident	267	250	294	811
Urgent				
Abdominal Pain	397	418	439	1,254
Accident Unknown PI	283	244	266	793
Animal Bite	21	13	13	47
Attempted Suicide	48	46	47	141
Back Pain	170	166	198	534
Domestic Violence	104	97	119	320
Minor Bleeding	18	7	13	38
Diabetic	357	320	365	1,042
Heat/Cold Emergency	8	13	30	51
Eye Problems	17	18	30	65
Falls/Back Injury Minor	169	143	180	492
Headache	21	22	26	69
Home Medical Alarm	106	69	82	257
Overdose	134	149	154	437
Person Check	208	204	224	636
Psychiatric	248	198	270	716
Sick Person	2,166	2,305	2,389	6,860
Non-Emergency				
Public assist				
First Aid Call	92	88	98	278
Transport only				
Non-emergency Transport	2,898	3,035	2318	8,638
Total	14,992	15,173	15,260	45,425
Daily Average	41	42	42	41

Hazardous Materials Incidents

Lynchburg Fire & EMS operates a hazardous materials response team that is not one of the Virginia Department of Emergency Management's contract teams. Hazardous materials calls, like all infrequent call types, are not evenly distributed over time. The department has experienced increases and decreases in the frequency of hazardous materials incidents from year to year for various reasons. There is now a greater awareness of the department's hazardous materials team in the community which results in the reporting of incidents that may have previously gone unreported. Additionally, the processing of calls through the dispatch center, as well as the call handling and response by the LFD is now more accurate. The reporting mechanisms are now in place to better support response to hazardous materials calls for service, which has also resulted in the increase in calls for service. However, it has been identified that there is the need for more accurate reporting and documentation of hazardous materials responses.

Table 4.10 **Frequency of Hazardous Materials Incidents: 2008-2010**

Call Type	2008	2009	2010	Total
Biological	0	0	0	0
Chemical	0	0	0	0
Bomb Discovered/Threat	8	4	1	13
Carbon Monoxide Alarm	47	56	52	155
Fuel Spills	70	73	53	196
Natural Gas Leak/Odor	88	103	118	309
Total	213	236	224	673
Daily Average	0.6	0.6	0.6	0.6

Technical Rescue Incidents

Technical rescue calls for service include high/low-angle rescue, trench rescue, structural collapse, confined space rescue (included contracted stand-by services), extrication, and diving & swift water rescue. The technical rescue team has established a program called *Partners in Emergency Response* (PIER). The PIER program was formed to provide area business and industries with the continued availability of specialized emergency services. The partnership meets the Occupational Safety and Health Administration (OSHA) ruling that amended the 1910.46 Permit Required Confined Space regulation effective February 1, 1999. The purpose of the amended regulation was to provide clearer guidance for the selection of a properly prepared rescue service and its ability to demonstrate that it is rescue capable.

When employees at contracted sites make an entry into a confined space, the technical rescue team is notified to ensure its availability and to place the team on stand-by. Therefore, all PIER stand-bys in the chart below could be classified as potential confined space entries.

The technical rescue team recently added two components: dive rescue and swift water rescue.

Table 4.11 **Frequency of Technical Rescue Incidents: 2008-2010**

Call Type	2008	2009	2010	Total
PIER Stand-bys	150	160	247	557
Confined Space	0	0	0	0
High-/Low-Angle	3	3	6	12
Trench	1	1	1	3
Structural Collapse	0	0	0	0
Dive Team	0	1	2	3
Swift Water Rescue	1	2	1	4
Total	155	167	257	579
Daily Average	0.42	0.46	0.70	0.53

The technical rescue team has a low frequency of incidents to which it responds, however the consequences of such incidents are significant and the resources are invaluable when an incident does occur. There is a technical rescue incident or stand-by about once every 4 days.

Miscellaneous Calls

Like most community based fire service organizations, LFD serves as a multifunctional service provider, often becoming the "the social service of last resort." Citizen and public assistance calls for service make up a significant portion of service request at 23% of all non-EMS calls for service. Examples of miscellaneous calls include illegal burning, elevator entrapments, and smoke/noxious odors outside (or other suspicious conditions). They do not "fit" into other categories, yet they represent important and ongoing services being provided to the community. The table below reflects the frequency of miscellaneous service requests over the reporting period.

Table 4.12 **Frequency of Miscellaneous Incidents: 2008-2010**

Call Type	2008	2009	2010	Total
Illegal Burn	107	95	95	297
Elevator Entrapment	62	60	59	181
Smoke Odor Outside	69	65	56	190
Total	238	220	210	668
Daily Average	0.65	0.60	0.57	0.61

Mutual and Automatic Aid Incidents

LFD maintains a broad network of mutual aid agreements with surrounding jurisdictions. Mutual aid defines services provided to another area at the specific request of the jurisdiction having authority, and is granted whenever doing so will not leave areas of primary responsibility with an inadequate level of remaining protection. Automatic aid refers to agreements that provide a pre-determined level of cross-jurisdictional support, usually in boundary areas, without the need for a specific request. Lynchburg does not have any automatic aid agreements in place with surrounding jurisdictions.

LFD has witnessed a significant reduction in EMS mutual aid requests since 2004 as the three counties surrounding the City of Lynchburg have transitioned from mostly volunteer to predominantly career staff on a 24-hour per day basis.

The following table shows the number of times during each calendar year that LFD responded for mutual aid requests to other jurisdictions. These responses have been delineated by the county requesting aid.

Table 4.13 **Frequency of Mutual Aid By County, 2008-2010.**

Total Mututal Aid Incidents			
	2008	2009	2010
EMS	74	58	62
Fire	19	10	9
Total	93	68	71

Total Calls

This table demonstrates total call volume and frequency of all response by LFD. On average, the department currently responds to52 incidents each day.

Table 4.14 **Total Incidents and Frequency, 2008-2010.**

Risk Category	2008	2009	2010	Total
Fire				
Structure	388	305	315	1,008
Auto	94	98	86	278
Brush	67	77	83	227
Trash	14	10	9	33
Explosion	5	4	2	11
Transportation	1	2	1	4
Miscellaneous	238	220	210	668
Fire Alarms	1,271	1,095	1,097	3,463
Sub-total	2,078	1,811	1,803	5,692
EMS: Emergency				
Emergent	7,527	7,618	7,999	23,144
Urgent	4,475	4,432	4,845	13,752
Sub-total	12,002	12,050	12,844	36,896
EMS: Non-Emergency				
Public assist	92	88	98	278
Transport only	2,898	3,035	2,318	8,251
Sub-total	2,990	3,123	2,416	8,529
Other				
Hazardous Materials	213	236	224	673
Technical Rescue	155	167	257	579
Mutual Aid				
All Mutual Aid	93	68	71	232
Total	19,040	18,770	18,922	52,601
Average per Day	52	51	52	52

Additionally, it is worth noting that this categorization scheme dramatically understates the activity of the line response companies. Simply listing incident response activity fails to account for all of the training, prevention efforts, fitness activity and community education & events that are conducted or participated in each day.

Incident Summary

In summarizing the types and frequency of incidents, LFD, through risk analysis, has determined that a typical daily event in Lynchburg is an EMS incident. LFD

must adequately distribute response companies to handle these high-frequency, moderate-to-low risk events, while at the same time concentrating resources adequately to support requirements for maximum risk occupancies. LFD will strive to improve performance in these areas.

Due to the multi-disciplinary incidents that can be expected in Lynchburg, operational readiness is critical in all specialty areas, including technical rescue and hazardous materials response. Both of these specialties bring risks to both the fire fighters and the surrounding community. LFD is aware of those risks and prepared to mitigate risks to the best of its ability.

Community Expectations

Setting expectations after risks have been identified is part art, science and politics. Decisions on staffing levels/concentrations are part of establishing community expectations. Once a thorough evaluation and categorization of risk has been completed, it is expected that the department will start reviewing outcomes of any emergencies that occur in each risk category. The scientific part of this method is in knowing what historically have been the problems for each risk type in the community and the resultant outcomes. Were the outcomes acceptable to the fire department, elected officials and the community? The artistic and political steps are necessary to blend the historical experience with current expectations, ability to pay and political willingness to see the policy carried out.

Most communities will start with these general expectations that cross all risk levels or types. The fire fighting resources that are deployed in the community should be able to :

- Stop the escalation of the emergency when found.
- Respond with enough resources to address typical emergencies in each risk category without routinely calling for greater alarms or mutual aid.
- For EMS responses to arrive before brain death occurs in a full-arrest situation, and specialty rescues to be able to extricate and transport trauma patients to a designated trauma center within 60 minutes of the accident occurring.
- For hazardous materials incidents, to be able to identify the hazard, implement a program to protect nearby workers and/or citizens, stop the

leak or spill and be able to clean up or supervise the clean-up of the incident with the assistance of industrial resources.

The City Council will define acceptable level of risk for the City of Lynchburg, through resource allocation to LFD. The acceptable level of risk encompasses the reliability of the system, which in turn is associated with the potential consequences of not being able to satisfy every demand, by addressing every possible eventuality and combination of circumstances.

Low Risk – OVAP Score < 15:
The objective is to stop the escalation of a minor fire when found. Typically this means conducting a search for and rescue of any victims, confining the fire damage *to the room* of origin, plus limiting heat and smoke damage to near the room of fire origin. The first arriving unit is capable of starting rescue work or advancing a first hose line for fire control. The second engine and truck company provide additional personnel for tasks already started, plus ventilation, salvage, overhaul, and other work as necessary.

Moderate Risk – OVAP Score 15 – 39:
The objective is to stop the escalation of a minor fire when found. Typically this means conducting a search for and rescue of any victims, confining the fire damage *to the room* of origin, plus limiting heat and smoke damage to near the room of fire origin. The first arriving unit is capable of starting rescue work or advancing a first line for fire control. The second engine and truck company provide additional personnel for tasks already started plus, ventilation, salvage, overhaul, and other work as necessary.

Significant Risk – OVAP Score 40 – 59:
The objective is to stop the escalation of a serious fire where found. Typically, this means conducting a search for and rescue of any victims, confining fire damage *near* the room of origin, plus limiting heat and smoke damage to the area or floor of fire origin. The tasks of rapid intervention for rescue trapped firefighters, property salvage, and crew rotation require additional personnel on a fire scene in this risk category.

Maximum Risk – OVAP Score 60+:

The objective is to stop escalation of a major fire when found. Typically this means conducting a search for and rescue of any victims, confining the fire damage *to the floor* of origin, plus limiting heat and smoke damage to the area or floor of fire origin. The tasks of rapid intervention rescue for trapped firefighters, property salvage, and crew rotation with rehabilitation requires additional personnel on a fire scene in this risk category.

Emergency Medical Services – Emergent:
The objective is to stop the escalation of a medical emergency beyond the level of severity found at arrival by department personnel. Specifically, 1) assess patients and prioritize care to minimize death and disability, 2) intervene successfully in life-threatening emergencies, 3) stabilize patients to prevent additional suffering, and 4) provide basic and advanced life support and minor rescue for one to three patients.

Emergency Medical Services – Urgent:
The objective is to stop the escalation of a medical emergency beyond the level of severity found at arrival by department personnel. Specifically, 1) assess patients and prioritize care to minimize death and disability, 2) intervene successfully in life-threatening emergencies, 3) stabilize patients to prevent additional suffering, and 4) provide basic life support and minor rescue as necessary for one to three patients.

Hazardous Materials Incidents:
The objective is to stop the escalation of a hazardous materials emergency beyond the level of severity found at arrival by department personnel. Specifically, 1) recognize and stabilize the hazard(s) at incidents involving any substance (gas, liquid or solid) to include nuclear, biological and chemical releases, and 2) perform incident management actions necessary to ensure confinement and containment of a spill or leak in the critical early stages of an incident in a manner that will minimize the risk to life, property and the environment.

Technical Rescue Incidents:
The objective is to stop the escalation of a technical rescue incident beyond the level of severity found at arrival by department personnel. Specifically, 1) recognize and identify the need for technical rescue services involving incidents such as structural collapse, trench collapse, complicated or advanced vehicle

extrication, confined space rescue and high/low-angle rope rescue, 2) perform rescue or incident stabilization as necessary to accomplish life safety, property and incident stabilization. In cases of very large events such as a large structural collapse, perform initial steps toward incident mitigation, including size-up, requesting additional technical rescue services, performing rescue, shoring and other steps toward incident stabilization until additional outside resources arrive to assist.

Summary

LFD, through risk analysis, has determined that a typical daily event in LFD's jurisdiction is an EMS event. LFD must adequately distribute response companies to handle the high-frequency, moderate-to-low risk events, while at the same time concentrating resources adequately to support requirements of maximum risk occupancies. LFD will strive to improve performance in these areas.

Due to the multi-disciplinary incidents that can be expected in LFD's jurisdiction, operational readiness is critical in all specialty areas, including technical rescue and hazardous materials response. Each of these specialties brings risks to both the firefighters and the community. LFD is aware of those risks and prepared to mitigate risks to the best of its ability.

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